TRANSIMS TRAVELOGUE

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TRANSIMS TRAVELOGUE describes current activities within the TRANSIMS project.

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WHAT IS TRANSIMS?

The TRansportation ANalysis and SIMulation System (TRANSIMS) is one part of the multi-track Travel Model Improvement Program sponsored by the U.S. Department of Transportation, the Environmental Protection Agency, and the Department of Energy. Los Alamos National Laboratory is leading this major effort to develop new, integrated transportation and air quality forecasting procedures necessary to satisfy the Intermodal Surface Transportation Efficiency Act and the Clean Air Act and its amendments.

TRANSIMS is a set of integrated analytical and simulation models and supporting data bases. The TRANSIMS methods deal with individual behavioral units and proceed through several steps to estimate travel. TRANSIMS predicts trips for individual households, residents and vehicles rather than for zonal aggregations of households. TRANSIMS also predicts the movement of individual freight loads. A regional microsimulation executes the generated trips on the transportation network, modeling the individual vehicle interactions and predicting the transportation system performance. Motor vehicle emissions are estimated using traffic information produced by TRANSIMS.

PROJECT APPROACH

We are developing two interim operational capabilities (IOC) to cover the major TRANSIMS components: Household and Commercial Activity Disaggregation, Intermodal Route Planner, Transportation Microsimulation, and Environment (primarily vehicle emissions). As each IOC is ready and with the collaboration of a selected metropolitan planning organization (MPO), we will complete a specific case study to confirm the IOC features, applicability, and readiness. This approach should provide timely interaction and feedback from the TRANSIMS user community and interim products, capabilities, and applications.

Traffic microsimulation was emphasized in the first IOC, which we tested in a case study in the Dallas-Fort Worth region with the support of the selected MPO, the North Central Texas Council of Governments. The next IOC focuses primarily on the iteration among the Activity Demand, Intermodal Route Planner and the Transportation Microsimulation, but also will incorporate the capability for emissions predictions. The supporting case study will be situated in Portland, OR, where we are working with Portland Metro.

PRESIDENT CLINTON SEES TRANSIMS

On February 3, 1998, William J. Clinton, President of the United States, was shown a computer-generated animation of the results of the TRANSIMS Dallas-Fort Worth case study by Dr. John Browne, Los Alamos National Laboratory Director. The President visited Los Alamos to give a speech supporting the scientific research and technology necessary to ensure the safety and reliability of the nation's nuclear stockpile. He also acknowledged the Laboratory's contributions to meaningful advances to other pressing national security issues, such as environmental clean up and reducing greenhouse gas emissions. The TRANSIMS demonstration was one of only three technologies presented by the Director to the President and Frederico Peña, Secretary of Energy and former Secretary of Transportation.

IOC-2 PLANNING

We have begun initial planning for the case study that will demonstrate the capabilities of the second IOC. Although our plans are not yet firm, we are considering a study that involves activity demand forecast, intermodal trip plans, and microsimulation for all of the Portland Metro planning region. We also are considering a forecast scenario for a future year. We expect to include the most travel modes (auto, bus, light rail, walk, and bicycle) in the study, and a high occupancy vehicle analysis is receiving strong consideration. Trucks and freight also will be represented. The environmental analysis will involve emissions only, not air quality.

Portland Metro has provided us with an EMME/2 representation of the Portland transportation network as a starting point for our research and development of the methods for IOC-2. This EMME/2 representation has been augmented with additional features required by TRANSIMS such as pocket lanes, signals, and lane connectivities at intersections. Portland Metro also has begun generation of a detailed network for the base year transportation system. The detailed network starts with Tiger files and will be transformed into the TRANSIMS format. We have named this the "all streets" network. In addition, we have revised the TRANSIMS network representation to accommodate multi-mode transportation.

In the following sections, we report our ongoing efforts for extending our microsimulation and planner methods to multiple modes. We contracted with the National Institute of Statistical Sciences to adapt their activity forecasting methods for implementation within the TRANSIMS framework, and we are investigating an alternative activity forecasting method with Portland Metro.

MICROSIMULATION ENHANCEMENTS

The first TRANSIMS IOC was a vehicle-based simulation. For the next IOC, which considers multiple modes, we have begun to implement a traveler-based simulation. Travelers are persistent objects that must be tracked through the simulation. Car drivers and passengers must be matched with specific vehicles; transit passengers with specific routes. Drivers can no longer create vehicles, but instead must have a vehicle at a parking accessory before they can begin a trip. The vehicles they use must obey constraints such as remaining where they are parked and not become available elsewhere in the simulation. Travelers cannot appear in more than one place at a time in the simulation.

We added support to the TRANSIMS cellular automata microsimulation for transit vehicles. They follow assigned routes and stop at specific locations to pick up and discharge passengers. We added the ability to simulate multicell vehicles (i.e., longer than 7.5 meters) with vehicle-specific accelerations, maximum velocities, and capacities. We added carpooling and for non-microsimulated transportation modes, such as walking. We track every individual second by second in the simulation.

PLANNER METHODS

We are developing methods for formal language constrained shortest paths on a hierarchical network for use in the TRANSIMS Intermodal Route Planner. In these methods we create separate networks for each transportation mode. For instance, we may have separate networks for automobiles, buses, walking, bicycles, light rail, etc. Furthermore, within the transit networks we represent each route as a subnetwork.

The perceived or real costs of a link's traversal are assigned to each link in these networks. Where a mode change can occur, we have a transfer link between the two different mode networks. This transfer link also has the associated intermodal transfer cost whether it be time, money, and other attributes or qualities that may influence a traveler's mode decision.

Each link on a mode network also is assigned a label unique to the mode. For instance, the automobile network may be labeled 'c'; the bus network, 'b'; the walk network, 'w'; the rail network, 't'; etc. Then we establish a formal language that describes the sequence of labeled links, identifying mode choices, for paths through the network. For example, an all-walk path is described by w^+, where w^+ denotes a sequence of walk links. A walk to the bus stop, followed by riding the bus to a downtown stop, and then completing the trip with a walk to the work place is denoted by $w^+b^+w^+$. Some paths are not allowed—for example, $b^+c^+b^+c^+$ would be an unusual path for a commuter, requiring having an automobile stashed, and requiring jumping from bus to car and car to bus.

Thus we establish a set of allowed sequences within the formal language and assign probabilities for using each sequence. Initially the probabilities may be uniform. They may be conditional on the household demographics; for example, if a car is unavailable, the chances of c^+ being in the sequence are small. In our research, we have developed fast-running algorithms that find minimum cost paths having these labeled sequences through the multi-modal network and thus generate trip plans for travelers. After the microsimulation has executed the trips, in addition to updating the link costs, the information will be fed back to the planner to adjust the probabilities for picking the mode sequences. Mode splits thus can emerge from the iteration between the planner and the microsimulation. The technique has the advantage that when a forecasted transportation system or policy is simulated, the mode split depends on the system and policies.

We also are investigating path finding algorithms that find the closest destination from among several destinations when a traveler has several alternative locations for accomplishing his activities. Thus we are researching efficient interfaces between the route planner and the activity generation module, focusing on efficient ways to encode mode preferences and choices that depend on the order of performed activities. We are examining efficient algorithms for time-dependent, mode choice constraint shortest paths and routes, route problems with time window constraints and related scheduling and routing problems.

ACTIVITY DEMAND METHODS

We are pursuing three methodologies for generating activities for the population. The first is an interim methodology that only assigns work trips to the workers in the population. The trips are assigned by using both census and land use data. We generated a set of such activities using the population to identify the workers and the home location, and the land use to identify the work location. These activities are being refined as morning peak traffic conditions are studied and its effect on the morning work activity location is understood.

These activities are input to the router/planner to facilitate router/planner research. The activities generated at Los Alamos represent a base set that will be modified using feedback from the router/planner and the microsimulation. These activities are assigned to the synthetic households that were generated for Portland and placed on the EMME/2 network. This population will be placed on the "all streets" network, and activities likewise will be assigned to the links on the "all streets" network.

The National Institute of Statistical Sciences (NISS) is developing a second methodology. In this methodology they develop activities by resampling the Portland activity survey. Classification and regression trees are used to assign activity sets to complete households. The activities in the activity set then are assigned to individuals in the household. The activities are located by fitting a density function to the activity locations in the Portland survey. Land use surrounding the network links is used to refine the activity location. Mode choice is not available at this time in this methodology, but the methodology used by Mark Bradley could be employed.

Under contract to Portland Metro, Mark Bradley has generated a third set of activities. Using a nested logit approach, each person in the traveling population is given activities. The activity locations are based on characteristics of Traffic Analysis Zones (TAZ). The activity locations are assigned at random within the TAZ. This will change as land use in the vicinity of the links will be used to assign activity locations. Mode choice also is given in the activity set. It was determined by a logit fit to the Portland activity survey data.

As development of the latter two methods progresses, they will be continually evaluated for incorporation into the TRANSIMS methodology. The activity demand methods will have to be compatible with the feedback methods that use information from the router/planner and the microsimulation to adjust activity sequences, times and locations. Another important consideration will be how well the activity demand methods represent the sensitivity of individual and household activities to changes in the transportation infrastructure and policies. If both methods fit well within the TRANSIMS methodology and time and resources permit, we may compare the results from the two methods as part of the Portland case study.

FURTHER INFORMATION

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